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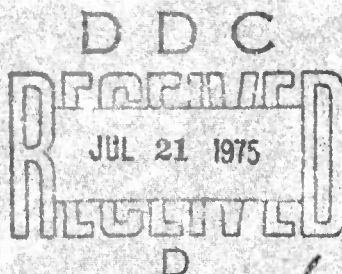
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EVALUATION OF A VERTICAL CONVEYORIZED ELECTRIC GRILL

by

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<p>A continuous vertical electric grill was evaluated from an engineering, food production and food acceptance point of view. Production rate, consistent with the quality criteria established, was found to be 250 hamburger patties per hour. The unit was limited to processing unfrozen meat patties only. No significant difference was found between the quality of patties cooked on this grill and those cooked on a conventional grill, except that those cooked on this grill were more consistent in quality and appearance.</p>		

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PREFACE

Acknowledgement is given to personnel of the Food Service Equipment and Evaluation Team, Food Systems Equipment Division, General Equipment and Packaging Laboratory for experimental testing of this equipment; and personnel of The Sensory Evaluation Unit, Food Acceptance Group, Behavioral Sciences Division, Pioneering Research Laboratory for carrying out the food acceptance portion of this evaluation.

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EVALUATION OF A VERTICAL ELECTRIC GRILL

1. Introduction

A vertical conveyorized electric grill* was evaluated to determine whether it is suitable for garrison food service operations and its relative merit from a sensory viewpoint compared to the manual grilling method. The evaluation encompassed three separate phases: (1) engineering, (2) food production, and (3) food acceptance.

2. Description of the Grill

The vertical conveyorized electric grill was designed primarily for the continuous broiling of ground beef patties. The grill is a counter top model fabricated from stainless steel with approximate overall dimensions of 64.77 centimeters (24-1/2 inches) wide, by 50.90 centimeters (20 inches) high, by 38.74 centimeters (15-1/4 inches) deep. A vertical moving conveyor chain belt of stainless steel moves the product being cooked from a loading section on the top, down between a grill surface and a broiler element, so that both sides are cooked simultaneously, and deposits the cooked product into a pan located below the grill.

The unit operates at 208 or 220 volts, 60 Hertz, 1-phase, a.c. and draws 30 amperes. Separate thermostats control the grill and broiler elements, and each has a pilot light. A Teflon coated sheet of fabric covers the grill surface so that the patties do not touch the grill surface; hence no residue is built up on the grill. Conveyor belt speed is constant. The production rate shown on manufacturer's literature is 250 hamburger patties per hour after the unit has been preheated.

The unit weighs 52.16 kilograms (115 pounds) and is illustrated in Figures 1 through 4. The unit bears the National Sanitation Foundation (NSF) Seal of Approval and is Underwriter Laboratories (UL) approved.

3. Testing

a. Engineering - The unit was connected to a nominal 208 volt, 60 Hertz, 1-phase, a.c. source, and power consumption was measured. Time required to pre-heat the grill from 22.2°Celsius (72°Fahrenheit) to 176.7°Celsius (350°Fahrenheit) and 204.4°Celsius (400°Fahrenheit) was recorded. The power shut-off switch, broiler thermostat, grill thermostat and signal lights were tested to determine functional operation. Wiring and wiring connections were examined for continuity, overheating, and tightness. Front panel surface temperature was recorded during the cooking operation, and the broiler socket release handle temperature was noted just after shutting off the power.

*Model HP-14, Serial No. 310 of American Permanent Ware Company, 729 Third Avenue, Dallas, Texas 75226

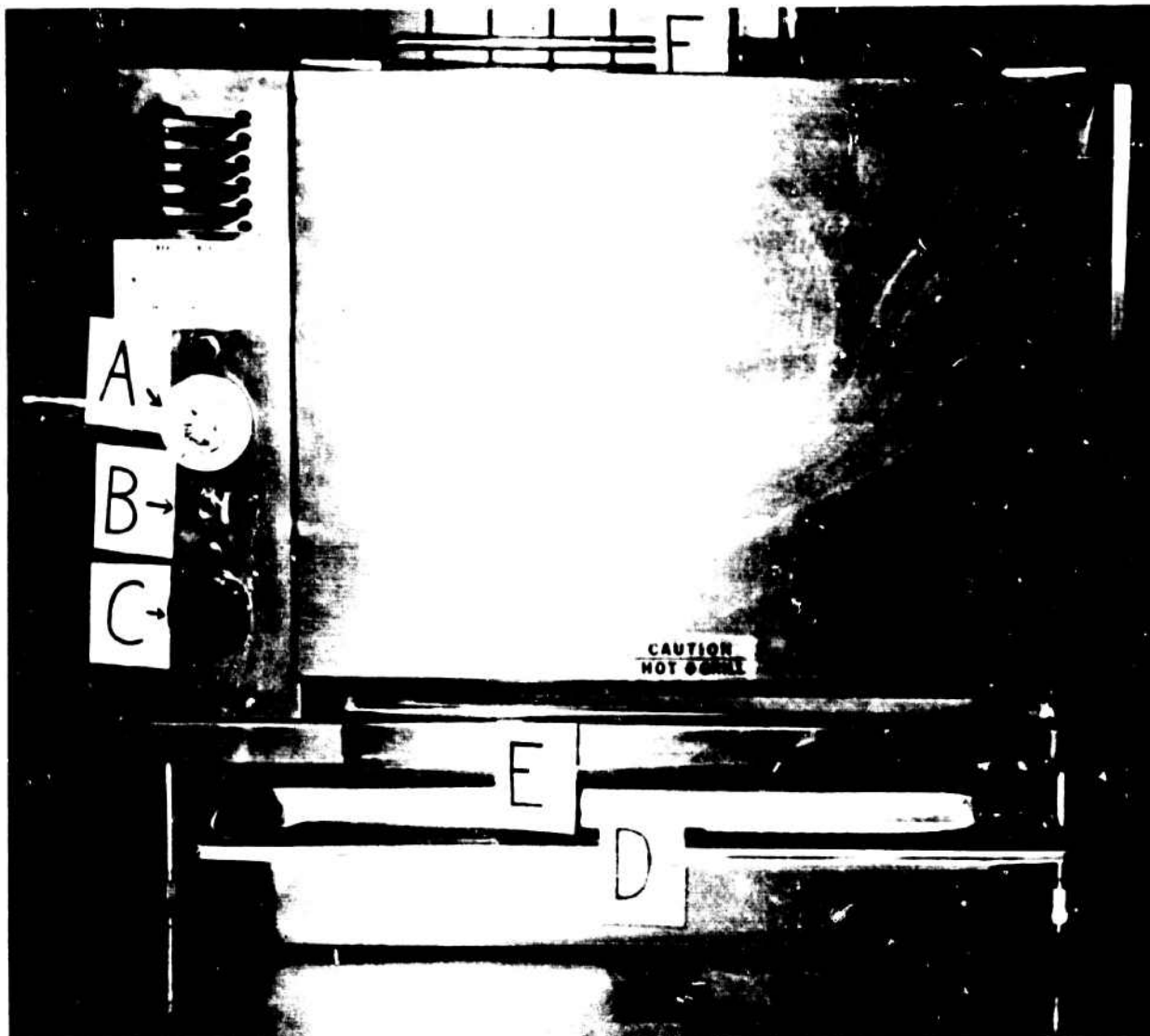


Figure 1 Front View

- A. Broiler Infinite Control Thermostat
- B. Belt & Broiler ON/OFF Switch
- C. Grill Thermostat
- D. Perforated Drain Pan
- E. Grease Gutter
- F. Handle Bar for Broiler/Chain Assembly

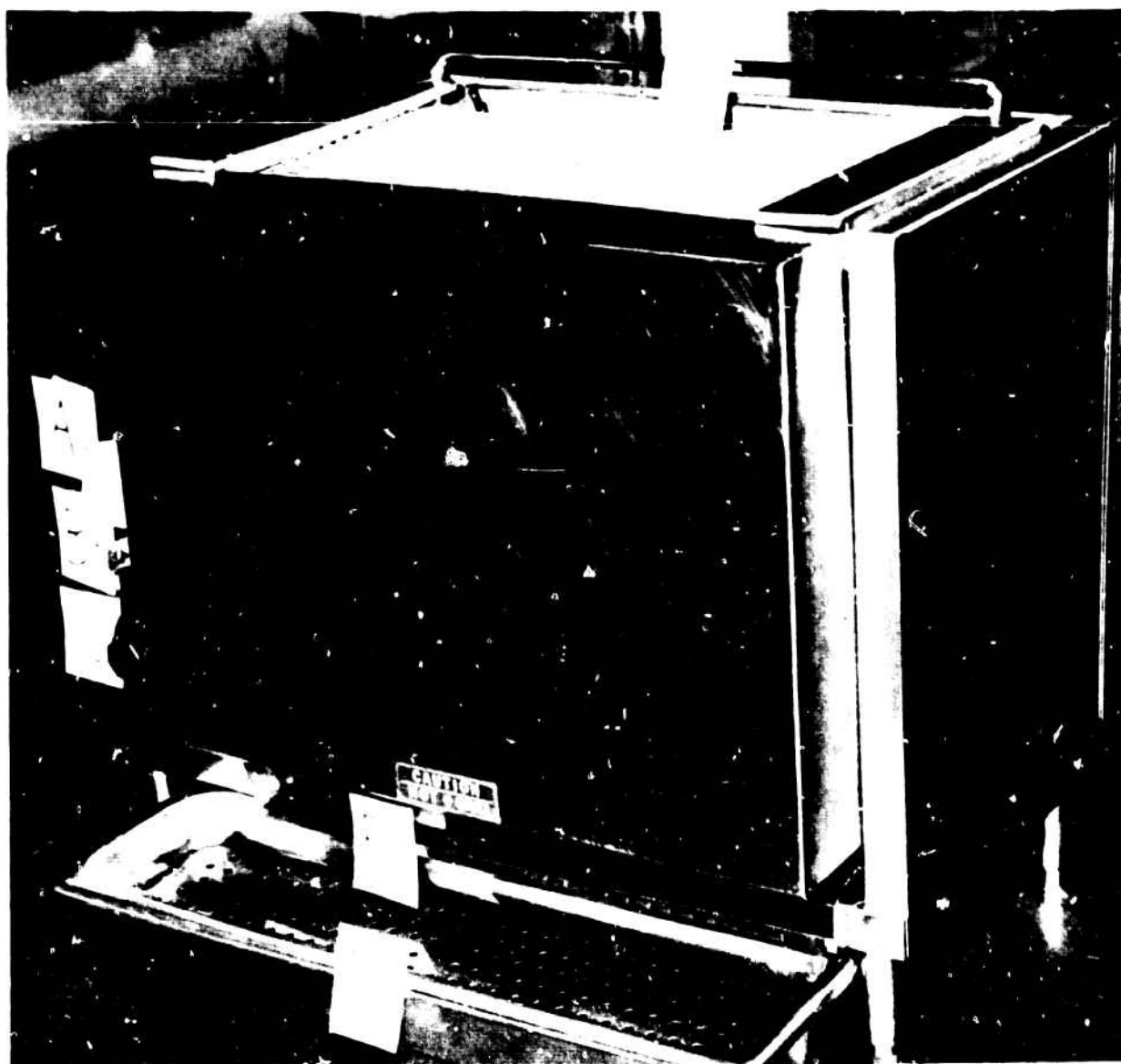


Figure 2 Side and Top View

- A. Broiler Infinite Control Thermostat
- B. Belt & Broiler ON/OFF Switch
- C. Grill Thermostat
- D. Perforated Drain Pan
- E. Grease Gutter
- F. Handle Bar for Broiler/Chain Assembly

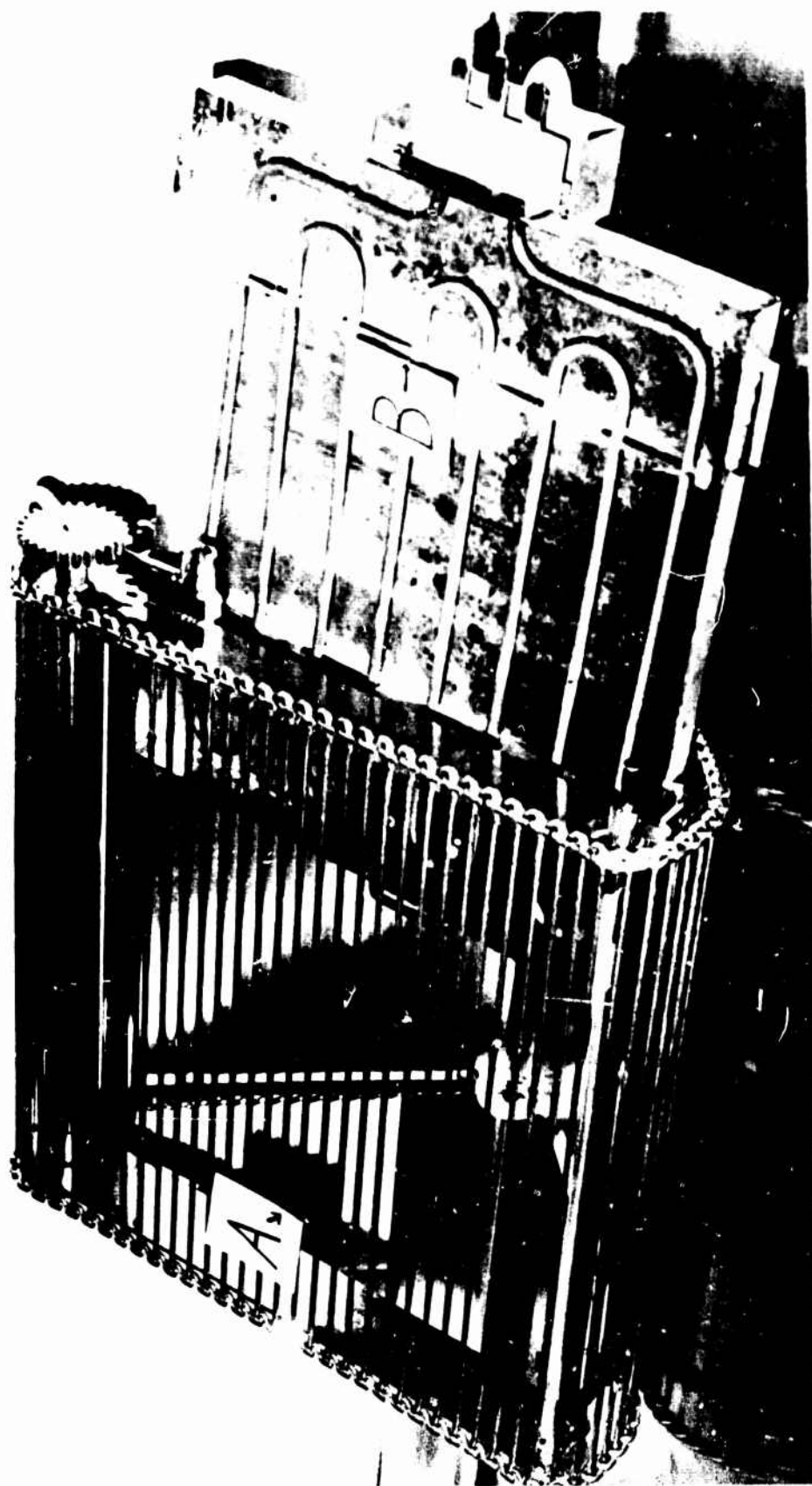


Figure 3 Chain & Broiler
Element Assembly

- A. Stainless Steel
Continuous Chain Belt
- B. Broiler Heating
Elements & Assembly

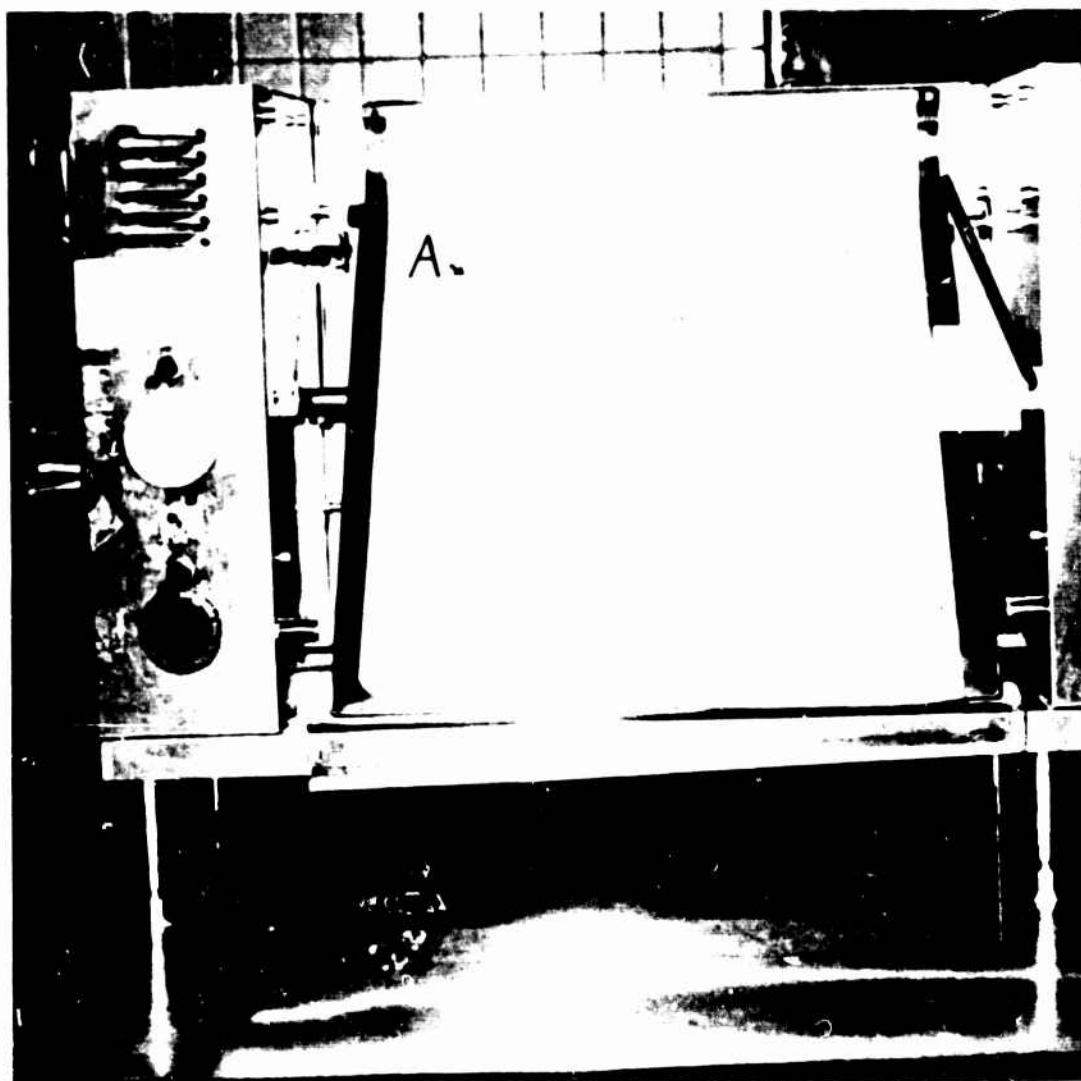


Figure 4 Internal View

- A. Teflon Coated Griddle
Plate Sheet
- B. Broiler Electrical Socket
Release Handle

The unit was completely disassembled for cleaning, and the time required and ease of removal and cleaning were determined.

b. Food Production - Refrigerated hamburger patties, made from ground beef conforming to MIL-B-3854, were used in the production phase of this evaluation. Patty weight is shown in Table I. Twelve (12) hamburger patties were used in each of six (6) test runs and then sixty-nine (69) patties were used for the seventh run. Initial patty temperatures and weights were recorded, and final cooked temperatures and weights obtained at various equipment settings were recorded, as well as the cooked percent yield. In determining the optimum cooking conditions the highest yield obtainable with a final internal product temperature of 71.1°Celsius (160°Fahrenheit) was recorded. A warm-up time of 10 minutes and 10 seconds was required to reach 176.7°Celsius (350°Fahrenheit), and 10 minutes and 30 seconds, to reach 204.4°Celsius (400°Fahrenheit).

c. Food Acceptability - An organoleptic comparison was made between hamburger patties prepared on a conventional grill and those prepared on the vertical grill to determine acceptability from the point of view of the consumer. A panel of 36 consumers was selected for the test.

4. Findings

a. Engineering - Measured power consumption was 7 kilowatts compared to the manufacturer's 6.3 kilowatt rating. The toggle switch shut off power to the broiler element and conveyor, but did not shut off power to the grill. Crimp connections at the switch were loosely installed. Internal wiring heated up noticeably. Both thermostats and signal lights functioned properly.

The front panel surface temperature exceeded 93.2°Celsius (200°Fahrenheit) while cooking. The broiler socket removal handle was too hot to touch and retained the heat for about 20 minutes after shut-off before it could be handled for cleaning.

The unit is easily disassembled for cleaning and required about 2-1/4 minutes; however, it was necessary to allow the equipment to cool before attempting to disassemble and clean. The gear assembly, chain, Teflon grill pads and grease drain must be washed by hand. All other components can be washed in a dishwashing machine. The Teflon pads were about 2.54 centimeters (1 inch) too short allowing grease to splatter on the exposed grill making the grease difficult to remove. The edges of the Teflon appeared to be wicking grease. The frame under the bottom edge of the grill, and the rods on the gear assembly were also difficult to clean. Cleaning time was 32-1/2 minutes, and reassembly required another 4-1/4 minutes.

b. Food Production - The cooked weight and internal patty temperature were recorded, and the yield percentage was calculated. Results are shown in Table I. The yield was greatest at "LOW" broiler setting and 176.7°Celsius (350°Fahrenheit) grill setting. The last run was made to determine production capacity as well as yield percentage. A grill setting of 204.4°Celsius (400°Fahrenheit) and a broiler setting of "HIGH" were required to obtain fully cooked patties at the manufacturer's stated rate of 250 per hour.

Table I. Actual Cooking Results

Temperature Settings		Quantity of Patties	Initial Temperature		Final Temperature		Initial Weight		Final Weight		Percent Yield
Grill	Broiler		°C	°F	°C	°F	Kg	Ozs.	Kg	Ozs.	
176.7	350	12	5.27	41.50	49.44-62.22	121-144	1.01	35-3/4	0.83	29-1/4	81.8
176.7	350	12	6.00	42.80	72.78	163	0.99	34-5/4	0.74	26	74.8
190.6	375	12	5.56	42.00	67.22-75.00	153-167	1.02	36	0.74	26	72.2
204.4	400	12	5.22	41.40	72.22-77.22	162-171	1.02	36	0.72	25-1/2	70.8
218.3	425	12	5.11	41.20	72.22-76.67	162-170	1.03	36-1/4	0.73	25-3/4	71.0
232.2	450	12	5.56	42.00	78.89-82.78	174-181	1.02	36	0.72	25-1/2	70.8
232.2	450	69*	5.00	41.00	76.67-80.56	170-177	5.89	207-3/4	4.27	150-1/2	72.4

*This run took 16-1/2 minutes.

c. Food Acceptability - An analysis of the results expressed by the panel of 36 consumers shows that at the 95% confidence level there was no significant difference in acceptability between the patties prepared on a conventional grill and those prepared on the vertical grill.

5. Conclusions

The vertical grill has sufficient power to meet the claimed production level of 250 patties per hour. A production of 250 patties per hour was the maximum rate that could be obtained.

The unit was limited in that it could only process refrigerated meat patties. It could not process frozen patties because they could not negotiate the 90° turn from the loading position down between the grill and broiler. When they were physically placed between these elements, they were not cooked sufficiently on a single pass.

The equipment did have the advantage that consistent product quality was not dependent on the skill of the cook. It was possible to make a cheeseburger of sorts by placing a slice of cheese on a patty immediately after cooking.

The addition of a switch to cut off all power to the grill is considered necessary. Additional insulation on the front panel and relocation of the handle would provide greater safety for operators.

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